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A NEW SPECIES OF DOUGLASIIDAE (LEPIDOPTERA) FROM THE EASTERN NEARCTIC

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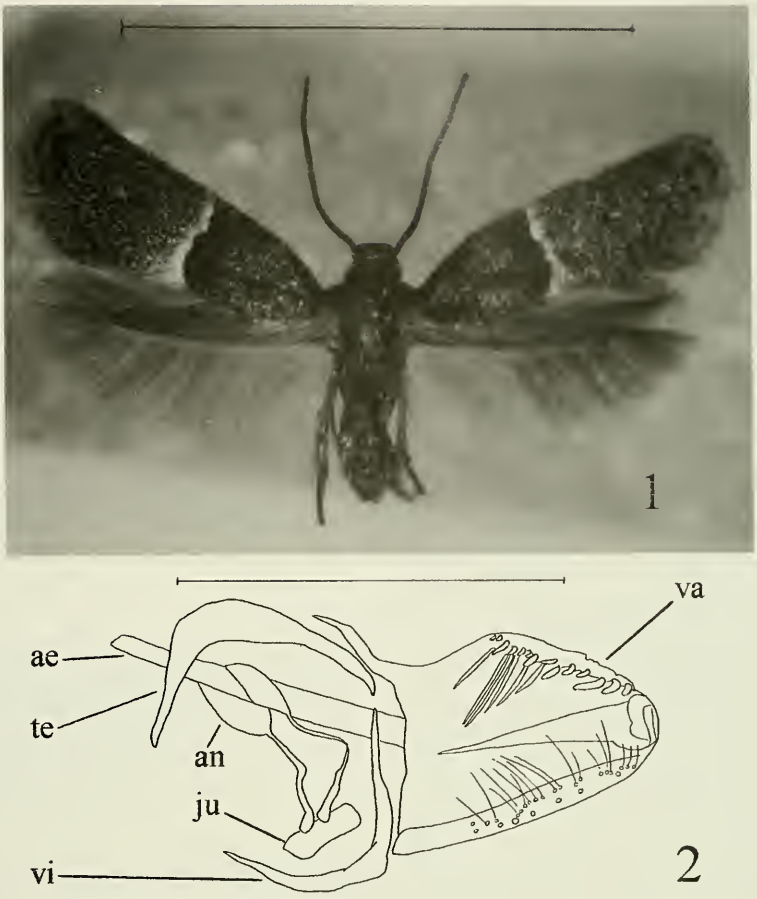
Abstract.—**Tinagma gaedikei, n. sp.** (Lepidoptera: Douglasiidae), is described from adult specimens collected in central Illinois, USA. The new species belongs to a lineage that includes three Nearctic species of *Tinagma* Zeller from California and northern Mexico, plus several Palearctic species, including *Tinagma balteolellum* (Fischer von Röslerstamm).

Key Words: Microlepidoptera, biogeography, taxonomy, *Tinagma, powelli, californicum, mexicanum,* Boraginaceae, *Echium,* Hydrophyllaceae, *Phacelia*

Douglasiidae is a small (ca. 25 described species worldwide) family of microlepidoptera occurring primarily in the Palearctic and Nearctic regions, with one representative species each in the Neotropical, Oriental, and Australian regions (Heppner 1984, 1991; Nielsen 1996; Davis and Robinson 1999; Powell et al. 1999). Gaedike (1974) published a revision of Palearctic Douglasiidae, and three additional Palearctic species have since been described (Gaedike 1987, 1991). Nearctic Douglasiidae were revised by Gaedike (1990). Biological information on the immature stages of Douglasiidae is scant; larvae of the few species that have been reared are leaf miners, flower petiole miners, and stem borers, utilizing Rosaceae, Lamiaceae, Boraginaceae, and possibly Hydrophyllaceae (Heppner 1987, Gaedike 1990, Powell et al. 1999).

Especially because of the paucity of definitive knowledge of the immature stages of Douglasiidae, placement of the family within Lepidoptera is problematic. Heppner and Duckworth (1983) and Heppner (1987, 1991) assigned it to Yponomeutoidea; Kyrki (1984) to Tineoidea; Heppner (1998) to Tineoidea, Series Gracillariiformes; and Davis and Robinson (1999) to Gracillarioidea. A point of particular uncertainty is the status of the pupa. Heppner (1987) stated that douglasiid pupae "are reported to remain in the pupal chamber at adult eclosion" (which implies yponomeutoid association), whereas Davis and Robinson (1999) said of the pupa, "reportedly with abdominal tergal spines (Kyrki 1984) and partially extruded from cocoon prior to adult eclosion" (which supports placement in Tineoidea/Gracillarioidea). Confirmed rearings of Douglasiidae, with preserved immatures and detailed biological notes, are needed to shed light on the taxonomic affinities of this family.

Gaedike (1990) observed that, on basis of genital morphology, known Nearctic Douglasiidae (all of which are placed in the genus *Tinagma* Zeller) divide into two groups, each of which Gaedike informally named on basis of a Palearctic species of *Tinagma* with which each respective Nearctic group shows affinity. The *Tinagma perdicellum* Zeller group (three western and



Figs. 1–2. *Tinagma gaedikei*. 1, Adult moth, dorsal aspect. Scale bar = 5.0 mm. 2, Male genitalia, caudal aspect, right valve reflected laterally, left valve removed; te, tegumen; ae, aedeagus; an, anellus; ju, juxta; vi, vinculum; va, valve. Scale bar = 0.5 mm.

one eastern species in the Nearctic) has no acuminate process at the apex of the male valve and no large, serrately-margined sclerotized plate associated with the ostium bursae of the female. Known larval food plants of the *T. perdicellum* group in the Nearctic include species of Rosaceae (Heppner 1987).

The *Tinagma balteolellum* (Fischer von Röslerstamm) group (three Nearctic species from California and northern Mexico) has an acuminate process at the apex of the male valve and a large, serrately-margined sclerotized plate associated with the ostium bursae of the female. Confirmed larval food plant associations have not been published for the Nearctic species of this group, but two of those species have been collected as adults on plants of the genera *Cryptantha* Lehmann (Boraginaceae) and/or *Phacelia* Jussieu (Hydrophyllaceae), and Gaedike (1990) speculated that these are probably the larval food plants of the associated moths. The taxonomically-affiliated Palearctic douglasiid, *T. balteolellum*, feeds as a larva on viper's bugloss, *Echium vulgare* Linnaeus (Boraginaceae).

In late April and early May 2004, I collected adults of an undescribed species of Douglasiidae in east-central Illinois, USA.

Genital morphology and association of the adult with flowers of *Phacelia* clearly align this insect with the *T. balteolellum* group, known previously in the Nearctic only from California and northern Mexico. Because this moth represents a substantial change in our knowledge of the biogeography of the species group to which it belongs, and because I wish to inform lepidopterists of the presence of this insect (especially in the hope that subsequently it will be reared), the species is described below.

Tinagma gaedikei Harrison, new species
(Figs. 1–12)

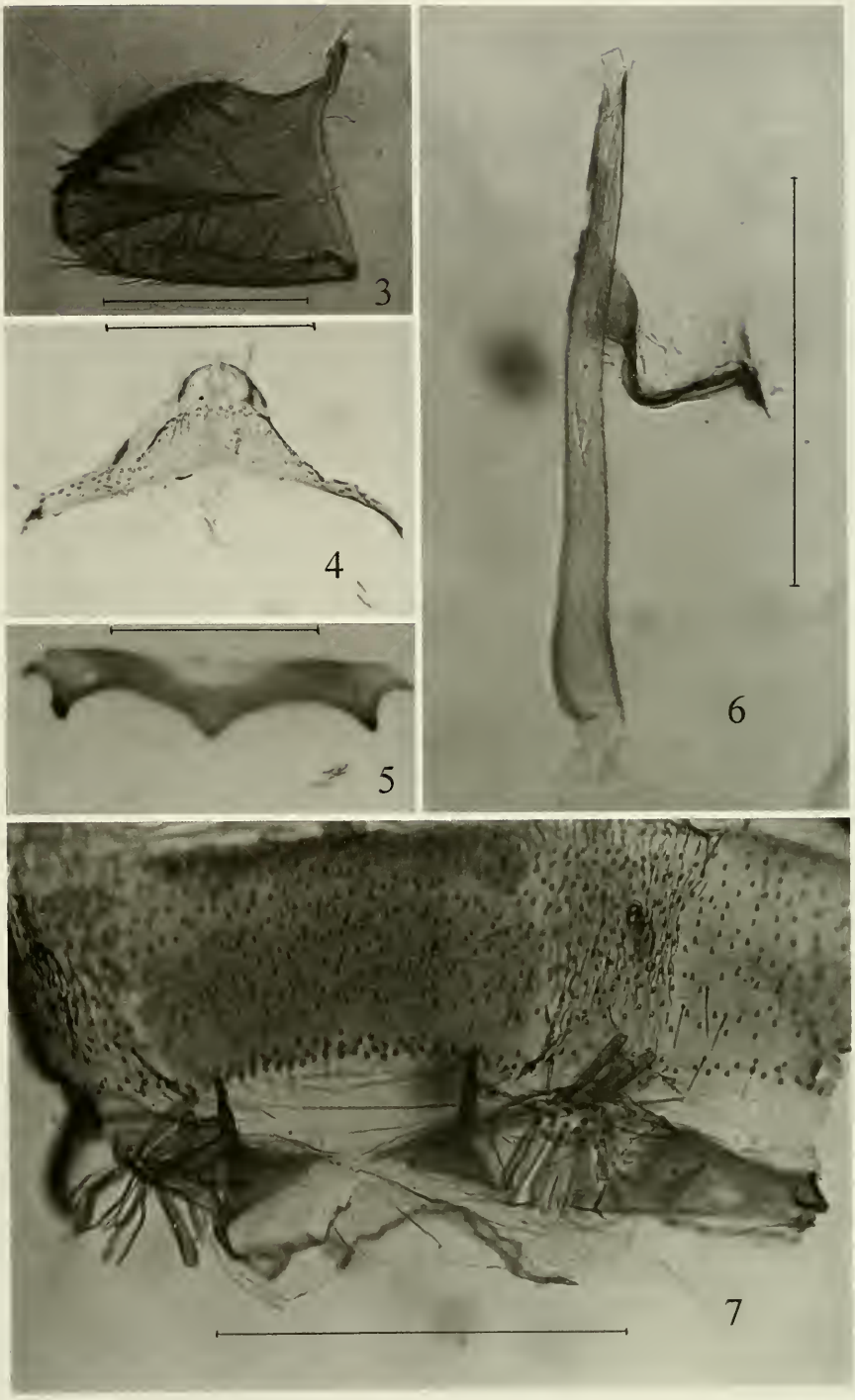
Adult (Fig. 1).—Male and female similar in appearance, not showing sexual dichromatism as some other members of the *T. balteolellum* species group. Mean forewing length 3.1 mm (n = 10, range = 2.6–3.3 mm); mean alar expanse 6.3 mm (n = 10, range = 5.0–6.8 mm).

Head: Smoothly scaled, dorsal surface shining dark gray, anterior 30 percent dark gray with slightly pale-tipped scales (= base of each scale dark gray, apex slightly paler gray); antenna uniformly dark gray, without pronounced pale annulations; face shining whitish gray; labial palpus shining whitish gray, second segment smoothly scaled, narrowly ringed apically with dark gray, and with a minute ventrolateral tuft at apex; maxillary palpus rudimentary, not evident; haustellum well developed, membranous, not scaled; compound eye well developed; lateral ocellus prominent.

Thorax: Dorsal surface shining dark gray; collar dark gray with slightly pale-tipped scales; wing venation typical for Douglasiidae, as illustrated by Covell (1984); vestiture on basal half of dorsal surface of forewing dark gray with slightly pale-tipped scales, and with strong coppery reflections in some angles of illumination; at apical edge of this dark-gray area, across entire width of wing, scales lack pale tips, giving impression of a narrow dark fascia; basal dark-gray area delimited apically by a narrow, perpendicularly-transverse white fascia occupying entire width of wing, widening slightly in area posterior to fold; basal margin of fascia slightly sinuate, apical margin nearly straight; apical half of wing beyond white fascia dark gray with prominently pale-tipped scales (= base of each scale dark gray, apex much paler gray), giving the area a uniformly speckled appearance, without metallic reflection; a very small patch of white scales (absent in some specimens) may be present in this area midway between anterior and posterior margins at about 0.75× length of wing; fringe dark brownish gray with dark-tipped scales forming two distinct lines; ventral surface of wing dark gray, with pattern of dorsal surface faintly discernible; hindwing and its fringe uniformly dark gray on dorsal and ventral surfaces; ventral surface of thorax shining whitish gray; on all legs, coxa, trochanter, and femur shining whitish gray, tibia and basal tarsomere dark gray with slightly pale-tipped scales, all other tarsomeres shining whitish gray ringed with dark gray at apices; meso- and metatibiae each with a small dorsoapical tuft projecting over base of tarsus; metatibia with a dorsal fringe of long, whitish hairlike scales along entire length of segment.

Abdomen: Dorsal surface shining dark gray; ventral surface shining whitish gray.

Male genitalia and associated structures (Figs. 2–7): Structures are interpreted based on characterizations given by Klots (1956). Valvae symmetrical; valve (Figs. 2–3) broadly subtriangular; apex of valve with an acuminate articulated process, 3.3× as long as its width at base, lying folded over medial surface of valve and projecting anterad to 0.8× length of valve; ventral margin of valve nearly straight, appearing as a uniformly narrow fold bearing long hairlike setae; apical 65 percent of dorsal margin of valve nearly straight, lying at 60° angle to ventral margin, and lined with a row of approximately 20 short thickened setae plus a few long flattened setae, the thickened setae increasing gradually in length from basal to apical ends of row; basal 35 percent of dor-



Figs. 3–7. *Tinagma gaedikei,* male genitalia and associated structures. 3, Left valve, medial aspect. 4, Tegumen, ventral aspect, flattened. 5, Vinculum, ventral aspect, flattened. 6, Aedeagus, anellus and juxta, left lateral aspect. 7, Seventh and 8th abdominal segments, cut longitudinally and spread flat to show external surfaces of terga, pleura, and sterna. Scale bar = 0.25 mm for Figs. 3–5, 0.5 mm for Figs. 6–7.

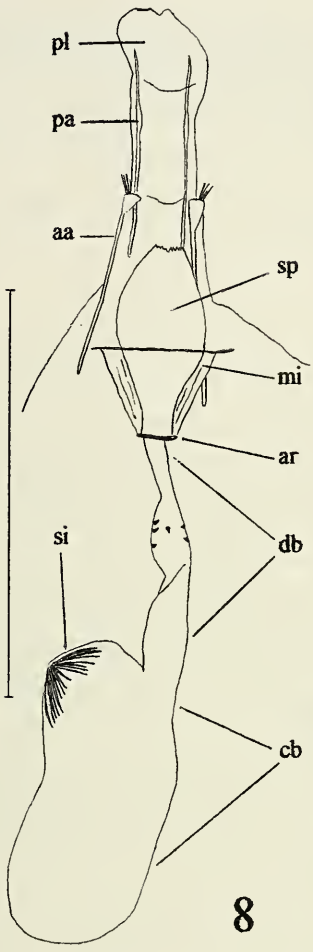
sal margin of valve devoid of setae, shallowly concave in an even curve, attenuated into a prominent anterodorsal process; tegumen (Figs. 2, 4) a dorsal hoodlike structure, narrowing laterally as it curves ventrad, its apices extending into close association with those of vinculum, the two structures together forming a sclerotized "ring" with which the valvae articulate; tegumen lightly sclerotized, composed of a large, anterior uniformly-punctate element and a small, medial rounded lobe, not punctate, projecting posterad from posterior margin of large element; vinculum (Figs. 2, 5) a ventral sclerotized band, curving dorsad, its apices coming into close association with those of tegumen; with anterior margin produced into a short saccus (Fig. 5); each lateral arm narrowest immediately laterad of saccus, then gradually broadening laterally, culminating in a trifid lateral margin, with anterior lateral process more pronounced and heavily sclerotized than posterior two processes (Fig. 5); juxta (Figs. 2, 6) a medial, transverse rectangular plate lying in close association with posterior margin of vinculum; anellus (Figs. 2, 6) two flattened plates lying in close contact with aedeagus on either side; juxta and anellus connected by two narrow, curved processes (apparently extensions of the anellus); aedeagus (Fig. 6) without cornuti, approximately 10× as long as width at base, narrowing gradually to apex, width at apex approximately 0.25× width at base; abdominal segment 8 (Fig. 7) showing two male-specific modifications: first, each pleural area with a small domelike lobe bearing 15–20 narrowly-clavate processes; and second, tergum with two lateral, triangular sclerotized patches, the anterior point of each triangle produced into a narrow tapering rod extending anterad to posterior margin of tergum 7; sternum of segment 8 uniformly sclerotized, unmodified.

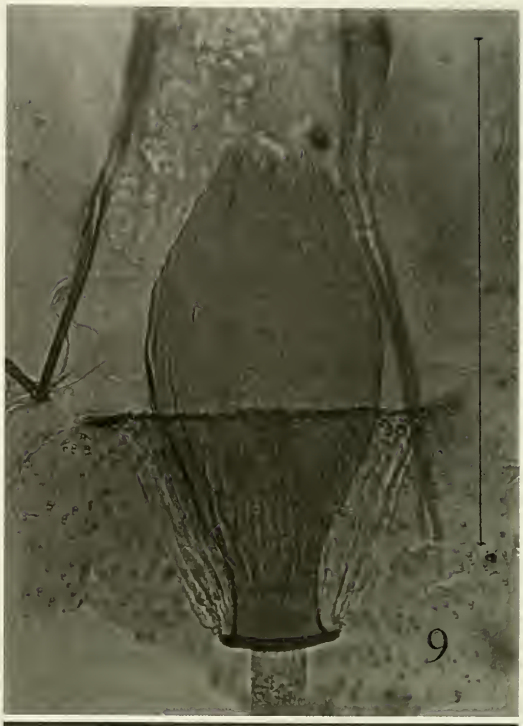
Female genitalia (Figs. 8–12): Ovipositor membranous; posterior apophyses filamentous, each slightly thickened near posterior end; anterior apophyses slender, each with a flat triangular enlargement at posterior end; a flat, broadly-fusiform sclerotized plate (Fig. 9) associated with ostium bursae; lateral margins of plate entire, posterior margin (Fig. 10) truncate and very finely serrate; anterior 45 percent of plate enveloped in a membranous, longitudinally-striate invagination, widest at its posterior margin (which is narrowly sclerotized ventrally), narrowing anteriorly at 65° angle and ultimately converging on a narrow, differentiated rim at anterior margin of sclerotized plate representing point of emergence of ductus bursae; ductus bursae lightly sclerotized in posterior half of length, membranous in anterior half, anterior limit of sclerotized region containing five or six small sclerotized spinules (Fig. 11); corpus bursae membranous, elongate-ovoid; signum (Fig. 12) a stellate patch of approximately 30 aciculate sclerotized rods, some of which may be sloughed off into interior of corpus bursae in mated specimens; abdominal segment 8 without modification.

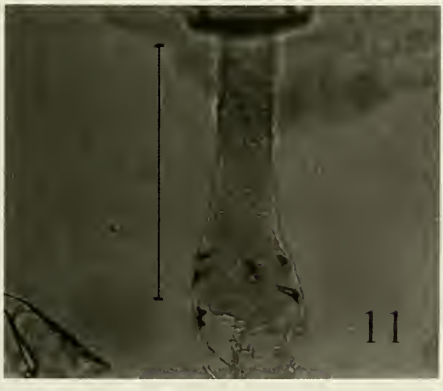
Type material.—Holotype male: Collected as diurnal adult on flower of *Phacelia purshii,* USA: Illinois, Coles County, T11N, R9E, Sec. 11, 29-IV-2004, T. Harrison (USNM, = National Museum of Natural History, Smithsonian Institution, Washington, DC, USA). Allotype female: Same data as for holotype, except collected 30-IV-2004 (USNM). Paratypes: 4 ♂, 4 ♀; same data as for allotype except 1 ♂ and 1 ♀ collected 6-V-2004, 1 ♂ collected 8-V-2004, and 1 ♂ collected 11-V-2004 (Deutsches Entomologisches Institut, Müncheberg, Germany; Illinois Natural History Survey, Champaign, Illinois, USA; and private collection of James R. Wiker, Greenview, Illinois, USA).

Etymology.—The species is named for Dr. Reinhard Gaedike, in recognition of his many years of dedicated study of the global fauna of Douglasiidae.

Biology.—Adults of *T. gaedikei* were collected in late April and early May in mesic deciduous forest on flowers of *Phacelia purshii* Buckley (Hydrophyllaceae). Moths







Figs. 8–12. *Tinagma gaedikei,* female genitalia. 8, Genitalia, ventral aspect; pl, papillae anales; pa, posterior apophysis; aa, anterior apophysis; si, signum; sp, sclerotized plate associated with ostium bursae; mi, membranous invagination enveloping anterior region of sclerotized plate; ar, anterior rim of sclerotized plate; db, ductus bursae; cb, corpus bursae. 9, Sclerotized plate associated with ostium bursae. 10, Detail of posterior margin of sclerotized plate associated with ostium bursae. 11, Posterior region of ductus bursae. 12, Signum. Scale bar = 1.0 mm for Fig. 8, 0.5 mm for Fig. 9, 0.125 mm for Fig. 10, and 0.25 mm for Figs. 11–12.

were collected between 1000 and 1200 Central Standard Time (observations were not made at other times of day), in conditions ranging from bright sunlight to heavy overcast. The pristine condition of collected adults and the presence of a spermatophore in one dissected female indicate that adults emerge and mate in late April and early May. Nothing else is known of the life cycle of this insect.

Geographic range.—*Tinagma gaedikei* has been recorded only from the type locality, Coles County, Illinois, USA.

Diagnosis.—The only known eastern Nearctic species of Douglasiidae other than *T. gaedikei* is *Tinagma obscurofasciella* (Chambers), which is placed in the *T. perdicellum* group (Gaedike 1990). *Tinagma gaedikei* differs from *T. obscurofasciella* in size, color pattern of the forewing, and genital morphology of both genders; the latter two characters in *T. obscurofasciella* were illustrated by Covell (1984) and Gaedike (1990), respectively.

The *T. balteolellum* group contains, in addition to *T. gaedikei,* three Nearctic species, *Tinagma powelli, Tinagma californicum,* and *Tinagma mexicanum,* all of which were described by Gaedike (1990). Forewing coloration of *T. gaedikei* differs from that of the three southwestern Nearctic species, as described by Gaedike (1990). In genital morphology, *T. gaedikei* lacks the setose globular development seen at the apex of the valve of *T. mexicanum* (the female of which is unknown). *Tinagma gaedikei* differs markedly from *T. powelli* and *T. californicum* in female genital morphology. The lateral margins of the ostial plate in *T. gaedikei* are entire (or very finely and sparsely serrate near posterior margin of plate), the posterior margin of the plate is uninterruptedly transverse, and the plate is widest at midlength. In *T. powelli,* the lateral margins of the posterior half of the plate are coarsely and densely serrate, and the posterior margin of the plate is divided by a deep medial cleft. In *T. californicum,* the plate is widest at its posterior margin, which is jaggedly quadrifid. Also, the geographic range of *T. gaedikei* probably does not overlap those of the other three Nearctic species of this complex.

Acknowledgments

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